

The Variegated Toad Agama in Djungar Gate (Eastern Kazakstan) with Notes on Certain Systematic Problems of *Phrynocephalus versicolor* Str. (Reptilia: Agamidae)

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**Abstract.**—The distribution of *Phrynocephalus versicolor* in Djungar (=Junggar) Gate (Eastern Kazakstan) was investigated. The characteristics of these lizards are: absence of red axillary spots and the presence of red-orange subcaudal coloration. The taxonomic status of this population and of subspecies of *P. versicolor* is discussed. The variegated toad agama is presumed to be a "composed" species.

**Key Words:** Reptilia, Sauria, Agamidae, *Phrynocephalus versicolor*, Kazakstan, China, Djungar Gate, systematics, distribution.

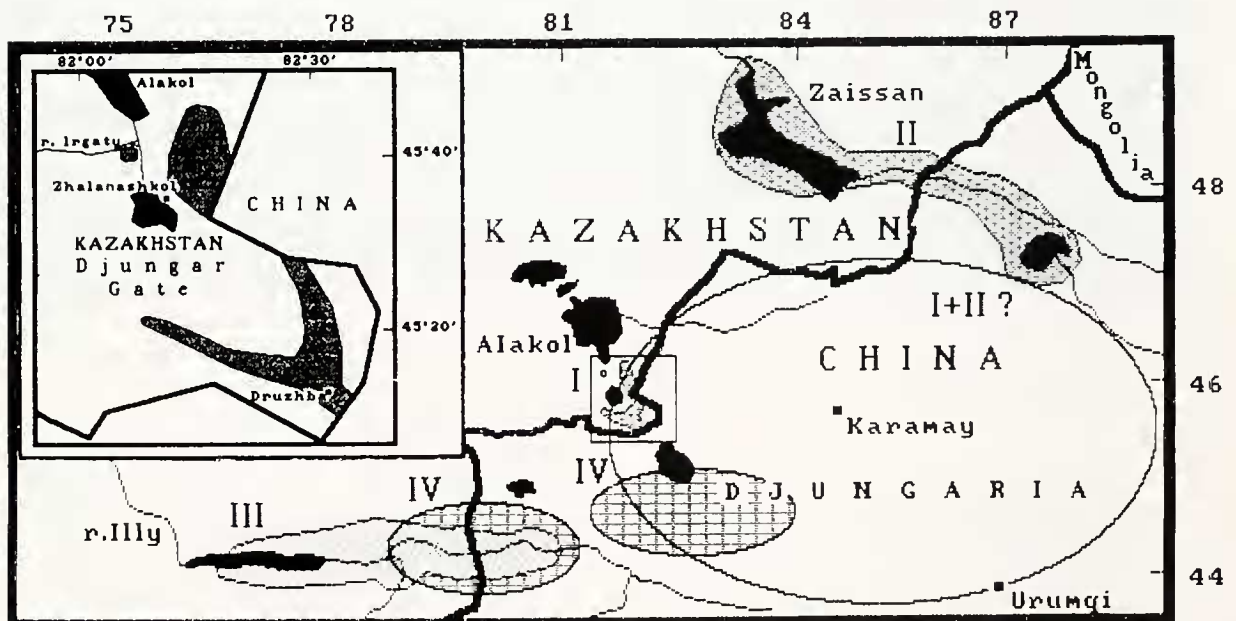


FIG. 1. The distribution of *Phrynocephalus versicolor hispida* (I), *P. guttatus salenskyi* (II), *P. g. alpherakii* (III), and *P. v. doriai* (IV) in Eastern Kazakhstan and Chinese Djungaria.

### Introduction

There are few reliable literature citations concerning the distribution of the variegated toad agama, *P. versicolor* Str. from the eastern part of the Balkhash-Alkol Depression. Only Paraskiv (1956) reported finding the toad agama "near Lake Zhalanashkol". He also indicated that the distribution of this lizard is a natural continuation of the the Djungar Gate in the Alakol Depression, "somewhere along the northern Lake Alakol shore" (Paraskiv,

1956). According to Kubykin (1975), one specimen of this lizard was captured by him on Sredniy Island (Lake Alakol). However, this specimen is not mentioned in the collection list of the Institute of Zoology of the Kazakh Academy of Sciences (Brushko and Kubykin, 1988). Semenov (1986) and Semenov et al. (1987) referred to toad agamas collected "from Alakol Hollow" in the Zoological Museum of Moscow State University. All other references to the distribution of this lizard cite the above references.



FIG. 2. Habitat of *Phrynocephalus versicolor* in Djungar Gate near Druzhba Railway Station: crushed-stony and gravel semidesert covered with boyalych (*Salsola orboscula*).

### Methods

We studied the distribution of the variegated toad agama in June 1991 during investigations of the Djungar Gate territory (Fig. 1).

### Results and Discussion

The Djungar Gate is a relatively narrow pass between the Balkhash-Alakol Depression and Chinese Djungaria. This pass is oriented from the northwest to the southeast and rising in elevation towards the southeast. The pass enters China near the Druzhba ("Friendship") railway station along the Lankol Valley. The Djungar Gate Valley is formed by the broad alluvial plain and gentle foothills of Maily Ridge and the Djavlau Mountains to the northeast and the more abrupt upthrust of the Djungar Alatau to the southwest. The surface of the valley alluvial plains varied with the degree of slope and ranged from boulders, rubble,

gravels and fine gravels on a loess base with the finer sorted materials deposited farther from the mountains slopes. Southeast of Lake Zhalanashkol the valley floor is a broad alkaline plain (20-25 km.) with subsurface water.

The dominate plant, *Salsola orboscula*, (common Russian name = boyalych, also known in the United States as Russian thistle) is found on the lower slopes and alluvial plains of the valley. It is more widely distributed on the northeastern slopes but it is sometimes replaced by saxaul (*Haloxylon sp.*). Wormwood (*Artemisia sp.*) is dominate among the grasses and nearly the only plant on flats without shrubs.

From the Lankol Valley the toad agamas are distributed along both the northeastern and southwestern slopes above the Djungar Gate. Along the southwestern alluvial plain the toad agama is distributed 15-20 km



from the Druzhba station to the northwest. The lizard occurs along the foothills of the Maily Ridge and the Djavlau Mountains for 55-60 km where the northern limit of its distribution coincides with the border of the boyalych dominate, gently sloping alluvial plain composed of rock rubble and gravels. Further north, on the steeper slopes of the alluvial plain composed of larger rock rubble and dominated by wormwood, the sunwatcher (*P. helioscopus*) is found. It is possible that *P. versicolor* occurs much further to the northeast into the Alakol Depression along the foothills, however field work in this area is difficult because of the presence of military installations along the border. A small isolated area with conditions which would make good habitat for this species is found along the railway tracks between the Zhalanashkol Station and the 19th Station near the mouth of the Irgaty River.

Toad agamas are found under single bushes in small groups composed of 1-2 males and 2-5 females of different ages. In addition, groups of up to 10 subadults were observed. The density of the lizards is variable, with higher densities in gravelly areas with boyalych (Fig. 2) as well as in areas of colonies of the great gerbil (*Rhombomys opimus*) that have excavated through the darker colored gravels and rock rubble and where the lighter loes makes up the predominant coloration of the surface.

It is interesting to note that the lizards inhabiting the gravel plains in the Djungar Gate have retained the sand burrowing behavior, involving rapid lateral movements of the body, observed in populations inhabiting sandy areas.

Pregnant *P. versicolor* as well as females of other *Phrynocephalus* species assume the "copulation avoidance" posture when pursued by males (Polynova, 1982; 1989; Rogovin, 1991; and our observations of *P. strauchi* in the Fergan Valley). To assume the "copulation avoidance" posture the female turns onto her back as the male approaches and maintains this position while he is nearby.

Currently *P. versicolor* is considered to be a polymorphic species and it is interesting to determine the subspecific position of the form inhabiting the Djungar Gate.

For a long time it was assumed that in eastern Kazakhstan this toad agama was found in three isolated populations: the Zaissan Depression, Alakol Depression and the Ili River Depression (Paraskiv, 1956; Bannikov et al., 1977). Peters (1984) considered the Zaissan Depression and Ili River Depression lizards to be two separate species: *P. salenskyi* Bedr. and *P. alpheraki* Bedr. Three years later a new subspecies, *P. versicolor paraskiwi* (Semonov et al., 1987), was described from the Ili River Depression. These authors speculated that the two Chinese Djungar Depression subspecies, *P. v. hispida* Bedr. and *P. v. doriai* Bedr. were conspecifics. However, because of a shortage of material, they did not determine the taxonomic status of the Alakol Depression variegated toad agama. Soon after the most significant attempt to analyze the intraspecific variation of *P. versicolor* was undertaken (Semenov and Shenbrot, 1989).

Semenov and Shenbrot (1989) examined 675 specimens: 580 from Mongolia and Tuva, 65 from the Ili River Depression, 19 from Chinese Kuldja (now Yining, Xinjiang, China), 11 from the Alakol Depression, but no specimens from the remainder of the range of this species in China. The authors, using discriminant analysis techniques, felt their material was adequate to discuss all known subspecies of the variegated toad agama.

Semenov and Shenbrot (1989) indicated that *P. v. paraskiwi* was detached from the main group. Also, *P. v. doriai* from Kuldja and *P. v. kulagini* from western Mongolia were resurrected. The Alakol variegated toad agama was singularly attributed to *P. v. doriai*. These authors were unable to distinguish the lizards from Mongolian Djungaria from "typical" *P. v. hispida*, however they did not indicate which *P. v. hispida* they considered

TABLE 1. Differences between Djungar subspecies of *Phrynocephalus versicolor* (after Bedriaga, 1909).

| Characters                       | <i>P. v. hispida</i>                                      | <i>P. v. doriai</i>              |
|----------------------------------|---|----------------------------------|
| Body length (L.)                 | 122 mm  | 133 mm                           |
| Tail length (L. cd.)             | Medium (male), short (female)                             | Long                             |
| Supraocular scales               | Slightly smaller than surrounding                         | Distinctly smaller               |
| Head scales                      | Large   | Small                            |
| No. of scales across top of head | 21-26 (23-24)   | 25-29 (rarely 23)                |
| No. of scales along top of head  | 10-13   | 12-15                            |
| Thigh scales                     | Smooth  | Smooth or keeled                 |
| Dorsal coloration                | Gray, olive, light brown, gray-brown                      | Dark gray, grey-brown, dirty red |
| Dorsal bands                     | Can be distinguished on shoulders and hind part of dorsum | Distinct to absent               |
| Ventral coloration               | White, throat and chest slightly pigmented                | Commonly dark                    |
| Axillary spots                   | Tracks of yellowish or pink-yellow spots may be present   | ?                                |

typical. They rejected their original view on the close relationship of the Djungar forms. *Phrynocephalus v. hispida* was recognized as identical to the nominative form.

Discriminant analysis also has shown that the presence of red axillary spots are useful characteristics for separating the closely related pairs of subspecies, *P. v. versicolor* - *P. v. kulagini* and *P. v. paraskiwi* - *P. v. doriai*. The remaining characteristics were found not to be useful for this purpose. This was already noted in earlier research (Nikolsky, 1915; Leroy, 1940; Terentjev and Chernov, 1949).

However, a number of questions remain unanswered. Has it been demonstrated that axillary spots are absent in *P. v. doriai* and in the Alakol toad agama? Is it appropriate to include in the nominative subspecies, characterized by the presence of axillary spots, the form *P. v. hispida* in which the axillary spots may be present or absent (Bedriaga, 1909)? If so, then what are the reasons for separating into distinct taxa *P. v. kulagini*, which lacks axillary spots and *P. v. paraskiwi* which has the axillary spots? The latter form should be excluded from further discussion since it has been shown (Golubev, 1989) that it was erroneously described and should be attributed to *P. guttatus alpherakii*.

Discriminant analysis did not clarify the relationship between *P. v. doriai* and *P. v. hispida*.

It is clear (Table 1) that such characteristics as the relative size of the head and supraocular scales can not be used unless they are standardized. Dorsal and ventral coloration vary widely and are effected in life by such physiological considerations as body temperature and ambient light and in preserved specimens by the manner of preservation. Body length to tail length, when expressed in ratios (Bedriaga, 1909) and repeated measurements of type specimens from the Zoological Institute of the Russian Academy of Sciences, St. Petersburg (ZIN) did not confirm the differences noted by Bedriaga (*P. v. hispida* ZIN 6637 females: 0.78-0.81; males 0.66-0.68; *P. v. doriai* ZIN 5549, 8160 females 0.71-0.74; males 0.64-0.72). The ratios could be confirmed by using liner dimension L. and L. cd. but this was not done. Two other characteristics, number of scales along and across the top of the head are known to vary widely among populations. Only presence or absence of axillary spots remains as a useful character for separating subspecies. However, we have no information concerning this character in *P. v. doriai*. Bedriaga (1909) used material that had been in preservative for more than

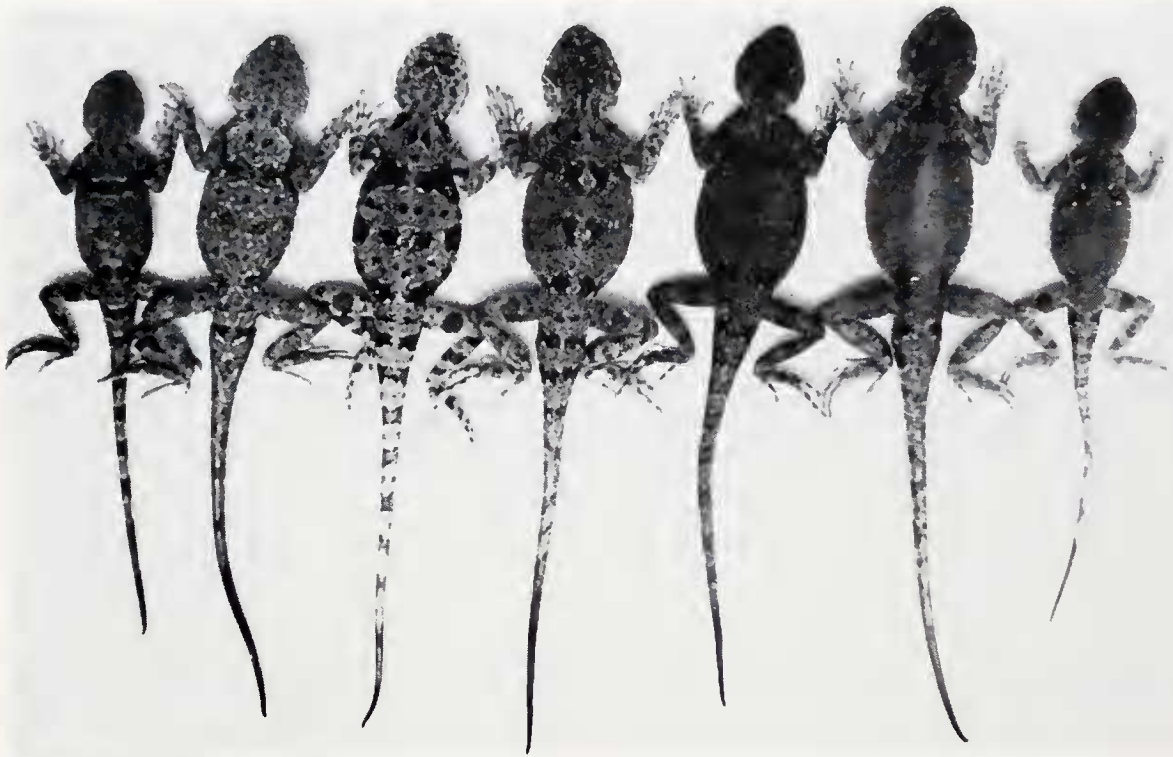


FIG. 3. Dorsal view of *Phrynocephalus versicolor* from Djungar Gate (Djungar Railway Station).

10 years and these spots might have disappeared during this time. Also there are no detailed data on the distribution of this character in lizards from eastern Djungaria. It is known only that such spots are present in the Mongolian part of the range of the toad agama (Semenov and Shenbrot, 1989). However, the nearly isolated Mongolian Djungaria (Barun-Khuray Depression) differs from Chinese Djungaria in several geographic parameters such as altitude.

The type specimens of *P. v. hispida* are dated 1879 (ZIN 6637 and 6638) and 1880 (ZIN 6639). Nikolay M. Przewalsky's Third Central Asian Expedition (First Tibetan Expedition) took place at this time (Dubrovin, 1980). Przewalsky left the city of Zaissan on March 21 (April 4 by the modern calendar) and reached Ulungur Lake (Ulungur Hu) on March 31 (April 12 by the modern calendar). He followed the Urungu River (Ulungur He) and its tributary the Bulugun to the Barun-Khuray Depression and crossed it from north to south. He then crossed the Baytik Shan

Ridge and the plains of south eastern Djungaria. On May 18 (May 30 by the modern calendar) he reached Barkul and did not return to Djungaria during this expedition (Przewalsky, 1883). In Przewalsky's journal the toad agamas (*Phrynocephalus* sp.) are casually mentioned for the middle and lower reaches of the river. Thus, it is possible to draw two conclusions: (1) the *P. v. hispida* type specimens may have been collected in different parts of Djungaria and thus include different forms, (2) the date of collection for the ZIN 6639 sample is incorrect.

There is an overlap between both subspecies of toad agamas from the Djungar Gate region in body proportions (females 0.6-1.06; males 0.64-0.75), number of scales across (19-29; not counting the supraocular scales) and along (8-14) the top of the head. The scales on the thigh are smooth and dorsal and ventral coloration are highly variable (Figs. 3, 4, 5). In the material we collected, a slight shift in these character's values toward



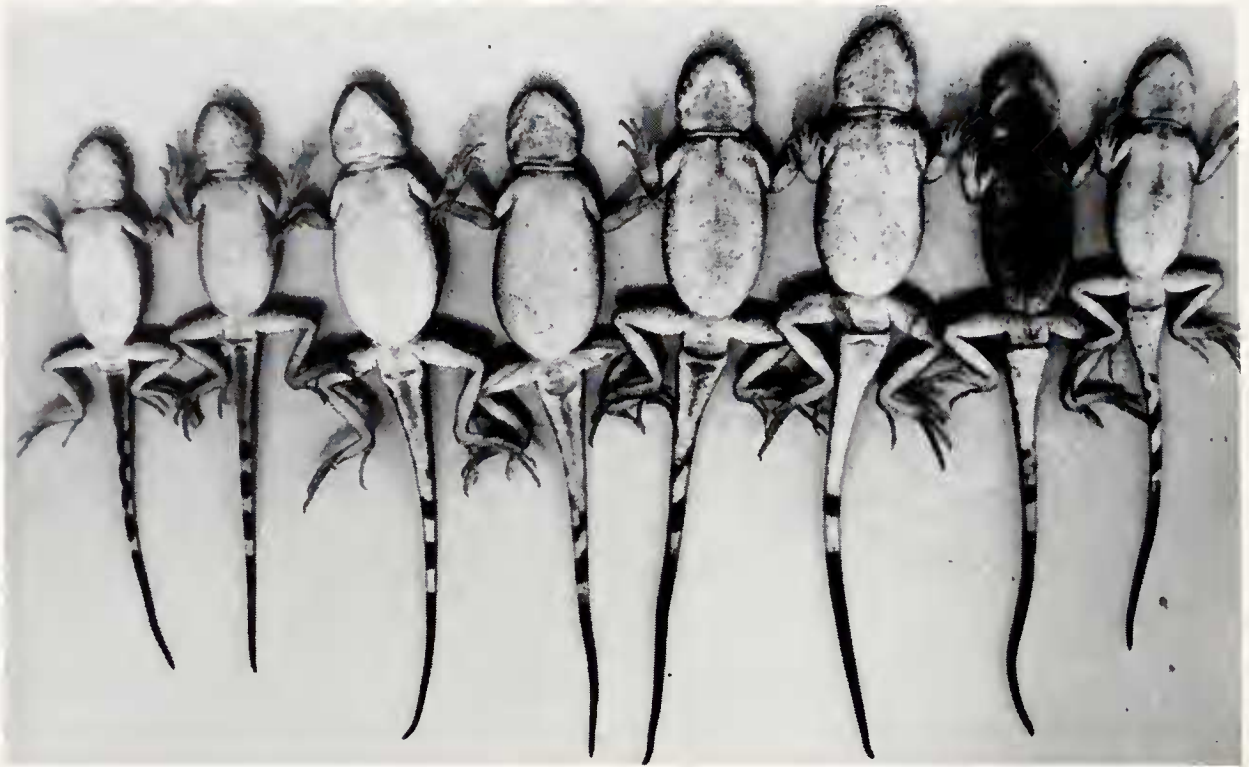


FIG. 4. Ventral view of *Phrynocephalus versicolor* from Djungar Gate (Djungar Railway Station).

*hispidus* can be noted. It is important to note that the subcaudal surface in living lizards of both sexes is a red-orange color, that with age loses its lustre and disappears (Fig. 4). We also discovered remnants of the red-orange coloration in one of 13 specimens from "Alakol Depression" (Zoological Museum of Moscow State University, MSU R7779). Recently we examined specimens from China with the same subcaudal coloration in the California Academy of Sciences collected in the central (northeast of the city of Karamay) and southeastern (east from the city of Urumqi) Djungaria. In all specimens examined there are dark transverse bars on the ventral tail surface and this agrees with Bedriaga (1909) but not with Semenov (1986).

From the above data, it follows that variegated toad agamas inhabiting the Alakol Depression and Djungar Gate to southern Djungaria (>500 km) differ from all other forms of *P. versicolor* in the absence of axillary spots and brightly colored subcaudal surface. Does this

indicate the existence of a new subspecies? There are also red tailed toad agamas in northern Djungaria and the Zaisan Depression variously described as *P. guttatus*, *P. salenskyi* and *P. versicolor*. In the Zaisan Depression this lizard is mostly sand-dwelling and similar in habits to *P. guttatus* and *P. frontalis* (Golubev, 1989), while in northern Djungaria and in some places in the Zaisan Depression they are found in more stabilized soils. From the Alakol Depression and the Djungar Gate, where this species is found, there are over 300 km of continuous habitat without noticeable barriers into central Djungaria where *P. versicolor* is found. This may represent a cline with a gradual transition from one form to the other.

In September 1991 repeated copulations between a male *P. salenskyi* (Zaisan Depression) and a female *P. versicolor* (Djungar Gate) were observed in the Kiev Zoo terrarium. If precopulation barriers exist, they apparently can be broken in terrarium conditions. Both Przewalsky (1883) and Potanin (1948), when traveling

along the lower reaches of the Urungu River and the southern shore of Ulungur Lake (type locality of *P. salenskyi*), noted the variable coloration of toad agamas. We discovered fragments of a light longitudinal caudal stripe (a characteristic of *P. g. salenskyi*) in some specimens of *P. versicolor* from Djungar Gate (Fig. 5). Red axillary spots are present not only in the Alashan variegated toad agama (species type locality) but in lizards inhabiting the area south of Beishan Ridge in the Gashun Goby. However, here *P. versicolor* are connected by coloration and pattern transitions with *P. axillaris* Blanf.

Thus, the question of the taxonomic status of the variegated toad agamas from Djungaria and Alakol Depression should again be considered open as does the question of the position of *P. v. doriai*. The Kuldja and western Djungarian populations are separated by the Tianshan Mountains. There are reasons to believe that the Kuldja *P. v. doriai* is actually an ecological race of the Ili *P. g. alpherakii* while the Ebinurian *P. v. doriai* is assignable to the *acutirostris* group (which also might be no more than one of the color variants of the *axillaris-guttatus* complex).

In summary, it appears that only two subspecies of the variegated toad agama can be recognized. *P. v. kulagini* inhabits southern Tuva and northwestern Mongolia and forms a narrow zone of intergradation with the nominative subspecies *P. v. versicolor*. However, there are doubts that the axillary red spots constitute a characteristic which allows one to delineate populations specifically on the level of geographaic race, i.e. subspecies. It is possible that *P. versicolor* consists of isolated, genetically differentiated color morphs associated with stabilized soils. Taxonomic separation of these variants should occur only after a detailed study of the entire group. Bedriaga (1909) recognized five subspecies and considered *P. versicolor* to be a species composed of many highly variable populations. Bedriaga expressed concern that his taxonomic arrangement of these subspecies did not represent a natural assemblage.



FIG. 5. A specimen of *Phrynocephalus versicolor* from Djungar Gate (Djungar Railway Station) with light longitudinal caudal stripe.

Further he stated "[only when we are more familiar with the fauna of Central Asia, will it be clear whether I have exaggerated distinguishing characters]". Leroy (1940) proposed that the species *P. versicolor* be abolished. Leroy's point of view may be closest to the truth.

#### Acknowledgments

The author is most grateful for the loan

of *Phrynocephalus* collections from M. E. A. Dunajev and Dr. V. F. Orlova of the Zoological Museum of the Moscow State University, Russia; Mrs. L. Jogansen and Prof. I. S. Darevsky of the Zoological Institute of the Russian Academy of Sciences, St. Petersburg; and Mr. J. V. Vindum and Dr. A. E. Leviton of the California Academy of Sciences, San Francisco, California, U.S.A. Also, I would like to thank Mr. V. B. Zaykovsky, Mr. G. Makhnin, and Mr. G. I. Zveryansky of the Railway Antiplague Service, Alma-Ata, Kazakhstan for the friendly help during the 1991 field season.

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